SECOND DRAFT
PM-1697

NOVEL SMOKING SYSTEM WITH IMPROVED FLAVOR DELIVERY AND METHOD FOR MAKING SAME

Cross Reference To Related Application

This is a continuation-in-part of copending, commonly-assigned United States Patent Application Serial No. 07/943,504, filed September 11, 1992.

Background Of The Invention

This invention relates to smoking systems in which cigarette cartridges are used with lighter modules, and methods for making the same.

An electrical smoking article is described in commonly-assigned United States Patent No. 5,060,671, which is hereby incorporated by reference in its entirety. That patent describes a smoking article which is provided with a disposable set of electrical heating elements on each of which is deposited an individual charge of tobacco flavor medium containing, for example, tobacco or tobacco-derived material. The disposable heater/flavor unit is mated to a source of electrical energy such as a battery or capacitor, as well as control circuitry to actuate the heating elements in response to a puff by a smoker on the article or the depression of a manual switch. The circuitry is designed so that at least one, but less than all of the heating elements are actuated for any one puff, and so that a predetermined number of puffs, each containing a pre-measured amount of tobacco flavor substance, is delivered to the smoker. The circuitry also preferably prevents the actuation of any particular heater more than once, to prevent overheating of the tobacco flavor medium thereon, and consequent production of undesired compounds yielding off tastes.

In such an article, the heating elements are disposed of along with the spent tobacco flavor medium. This results in

(A)

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please replace (A) with

~~please replace~~ with such articles, the heater is thrown away with the spent remainder of tobacco material. Also, the electrical connection between the heaters and battery - 2 - must be able to endure repeated release and reconnections as flavor units are replaced.

(A) increased costs to the smoker, who must buy new heating elements with each refill of tobacco flavor medium. The volume of material disposed of is also greater when the heating elements must be disposed of.

In addition, when the heating elements are disposable, they must, by their nature, be removable. As a result, there is sometimes excessive contact resistance at the connection where the removable heaters are electrically connected to the source of electrical energy, resulting in increased power ~~consumption. Furthermore, that~~ connection must be designed to withstand repeated insertion of new heating elements after each use.

Also, when the heating elements are disposable, the heater electrical resistance may vary from heater to heater, resulting in variations in power consumption which, in turn, can lead to variations in temperature. As it is the temperature to which the tobacco flavor medium is heated that determines the characteristics of the tobacco flavor substance, those characteristics will also vary.

~~The above-discussed shortcomings are addressed by~~ In copending, commonly-assigned United States Patent Application Serial No. 07/666,926, filed March 11, 1991, now abandoned in favor of Continuing Application Serial No. 08/012,799, filed February 2, 1993, ~~That application describes~~ is disclosed, an electrical smoking article that has reusable heating elements and a disposable portion for tobacco flavor generation. The disposable portion preferably includes a flavor segment and a filter segment, attached by a ~~plug wrap~~ tipping paper or other fastening ~~means.~~ arrangement with reusable heating elements, ~~A disadvantage of that~~ residual aerosol can settle and condense on the heating elements and other permanent structural components of the article, ~~resulting in the generation of undesirable aerosol components if the residual aerosol is reheated after new~~ which condition may impair proper operation of the device and adversely affect ~~the~~ taste.

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pls review
PM1550 discloses a cigarette cartridge comprising condenser tubes and reusable heaters.

~~disposable tobacco flavor medium is inserted into the article. Such residue is referred to as fixture contamination.~~

United States Patent Application Serial No. 07/943,504, filed September 11, 1992, which is hereby incorporated by reference in its entirety, describes another electrical smoking article that has reusable heating elements and a disposable portion for tobacco flavor generation. That application addresses the above-discussed problem of the generation of undesirable aerosol components resulting from the reheating of aerosol that settles or condenses onto the heating elements and other permanent structural components of the article. That application also describes a manufacturing process for making the disposable portion of the smoking article using conventional high-volume assembly machinery. Although that application describes some solutions to the above-described problems, they are not the only solutions. Other solutions for further improving electrical smoking articles, or smoking systems, are always desirable. In particular, improvements in the manufacturing of the smoking system can reduce cost to the smoker. Furthermore, improved aerosol and flavor delivery to the smoker is also a welcome feature in such smoking systems.

In light of the above, it would therefore be desirable to be able to provide an improved smoking system in which the heating elements ~~of~~ of the lighter module are reusable. ~~and of which the volume of disposable portions is minimised.~~

It would also be desirable to be able to provide such a system in which ~~generation of undesirable aerosol components resulting from the reheating of aerosol that settles or condenses~~ condensation of aerosol onto the heating elements and other structural components of the lighter module is minimized.

It would further be desirable to be able to provide ~~improved manufacturing processes for such a system that would reduce the cost to the smoker~~ a smoking article which is easier to manufacture.

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provide a smoking article which provides improved tobacco

It would still further be desirable to ~~be able to improve aerosol~~ and flavor delivery to the smoker.

Summary of The Invention

Accordingly, a primary object of the present invention is to provide a novel smoking systems which do ~~not incur, or which alleviate,~~ a avoid problems or disadvantages associated with prior systems. — HUH

Another object of the present invention is to provide improved flavor delivery from a smoking system in which cigarette cartridges are used with lighter modules.

It is also an object of this invention to provide a smoking system in which the heating elements ~~or~~ of a lighter modules are reusable, and of which the volume of disposable portions is minimized.

It is also an object of this invention to provide ~~such~~ a system in which ~~generation of undesirable aerosol components as a result of reheating of aerosol that settles or condenses~~ condensation of aerosol onto ~~the~~ heating elements and other structural components of ~~the~~ a lighter module is minimized.

It is a further object of this invention to provide a smoking article and ~~improved~~ manufacturing processes for ~~such a system that would reduce the cost to the smoker~~ making same.

It is a still further object of this invention to provide improved aerosol and flavor delivery to the smoker.

In accordance with one aspect of this invention, there is provided a cigarette cartridge or removable tobacco flavor unit for use in a smoking system for delivering to a smoker a tobacco flavor during smoking, the system having a lighter module including a plurality of fixed or permanent electrical means disposed in a cavity. The cigarette cartridge includes a carrier having first and second ends spaced apart in a longitudinal direction and having first and second surfaces adapted to allow transverse air flow therethrough, the first surface defining a flavorant cavity for generating

that are easier and cost effective, even at extreme mass production speeds

do you have a better term for this?

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the tobacco flavor substance between the first and second ends, and the second surface adapted to be disposed adjacent the plurality of electrical heating means. Tobacco flavor medium is disposed on the first surface of the carrier. When any one of the plurality of electrical heating means in the lighter module is activated, the tobacco flavor medium is heated, generating a predetermined quantity of tobacco flavor substance in the flavorant cavity for delivery to the smoker, wherein when a smoker puffs on the smoking article, the transverse air flow is generated for improving said delivery.

In accordance with another aspect of the present invention, there is also provided a lighter module for use in a smoking system for delivering to a smoker a tobacco flavor substance. The lighter module includes a housing defining a cavity for receiving a removable cigarette cartridge. The housing has a first air passageway adapted for providing transverse air flow through the cigarette cartridge. The lighter module also includes a plurality of electrical heaters disposed in the housing. ~~The heaters each have a surface adapted for disposing adjacent the second surface of the carrier in a region adjacent the transverse air flow.~~ When any one of the plurality of electrical heaters is activated, a predetermined quantity of tobacco flavor substance is ~~generated in the flavorant cavity for delivery~~ to the smoker, ~~wherein when a smoker puffs on the smoking article, the transverse air flow is generated for improving the delivery.~~ ~~If desired,~~ the heaters ~~can be formed in a shape of~~ a serpentine ~~pattern~~ for increasing the ~~electrical resistance of~~ the individual heaters.

The present invention, in another aspect, further includes a method for making an integrated heater structure for use in the lighter module of the present invention. This method includes the steps of (a) cutting a plurality of interconnected heater elements from a sheet of resistive material and (b) forming the sheet of heater elements into a

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X discharge should be mentioned (see FM 1345)

cylindrical shape to provide a plurality of independent heater elements each having (1) a first heater end and (2) a second heater end, the respective first heater ends being commonly coupled together to provide an electrical common, and the respective second heater ends being for activating the heater independently of other heaters.

NEEDS WORK

The present invention in another aspect also includes a smoking system for delivering to a smoker a tobacco flavor substance. The system can include both the lighter module and the removable cigarette cartridge.

Brief Description Of The Drawings

The above and other objects, aspects and advantages will be apparent upon consideration of the following detailed description, taken in conjunction with accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

FIG. 1 is a perspective view of an embodiment of a smoking system;

FIG. 2 is a partially fragmentary, exploded perspective view of the smoking system of FIG. 1;

FIG. 3A is a top plan view of the lighter module housing of the smoking system of FIGS. 1 and 2, taken from line 3A-3A of FIG. 2;

FIG. 3B is a bottom plan view of the lighter module housing of the smoking system of FIGS. 1 and 2, taken from line 3B-3B of FIG. 2;

FIG. 3C is a side plan view of the lighter module housing of the smoking system of FIGS. 1 and 2, taken from line 3C-3C of FIG. 3A;

FIG. 3D is a side plan view of the lighter module housing of the smoking system of FIGS. 1 and 2, taken from line 3D-3D of FIG. 3A;

Fig. 1 & 2 - A good cartridge & lighter but Fig. 3 not clear - should be explained as passible

Query: all the Figs showing possible flow required might be clearer/fuller

Preferable all airflow is directed radially inwardly through the cyl. walls

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need to see these drugs

my quick review of

FIG. 4A is a partially fragmentary, perspective view of the removable cigarette cartridge of the smoking system of FIGS. 1-3;

FIG. 4B is a longitudinal cross-sectional view of the removable cigarette cartridge of the smoking system of FIGS. 1-3, taken from line 4B-4B of FIG. 4A;

FIG. 5 illustrates the air flow contours in the smoking system;

FIGS. 6A, 6B, 7A, 7B, 8A and 8B illustrate various lighter module embodiments to provide air flow contours in accordance with the principles of the present invention;

FIG. 9 is a perspective view of a preferred embodiment of a lighter module;

FIG. 10 is a longitudinal cross-sectional view of the lighter module of FIG. 9, taken from line 10-10 of FIG. 9;

FIG. 11 is a partially fragmentary, exploded longitudinal cross-sectional view of the lighter module of FIGS. 9 and 10, taken from FIG. 10 and illustrating removal of the retaining cap/heater sleeve and the air channel sleeve;

FIG. 12A is a perspective view of the lighter module base of the lighter module of FIGS. 9-11;

FIG. 12B is a plan view of the lighter module base of FIG. 12A, taken from line 12B-12B of FIG. 12A;

FIG. 12C is a plan view of the lighter module base of FIG. 12A, taken from line 12C-12C of FIG. 12A;

FIG. 12D is a plan view of the lighter module base of FIG. 12A, taken from line 12D-12D of FIG. 12A;

FIG. 12E is a cross-sectional view of the lighter module base of FIG. 12A, taken from line 12E-12E of FIG. 12B;

FIG. 13A is a longitudinal cross-sectional view of the air channel sleeve of the lighter module of FIGS. 9-11;

FIG. 13B is a cross-sectional view of the air channel sleeve of the lighter module of FIG. 13A, taken from line 13B-13B of FIG. 13A;

FIGS 1 ✓ (yes)
2 ✓ (yes)
3 A-D maybe
4 ✓
4B ✓

5A ?
6A ?
6B ?
7A ?
7B ?

8A?
8B?
9 ✓maybe
10 ✓
11 ✓

12A? (too much like a blueprint?)
12E? (ditto)
12B-D (ditto)
13A?
13B?
14A-C ✓
15A,B?

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FIG. 14A is a perspective view of the retaining cap of the lighter module of FIGS. 9-11;

FIG. 14B is a plan view of the retaining cap of FIG. 14A, taken from line 14B-14B of FIG. 14A;

FIG. 14C is a cross-sectional view of the retaining cap of FIG. 14A, taken from line 14C-14C.of FIG. 14A;

FIG. 15A is a longitudinal cross-sectional view of the disposable heater sleeve of the lighter module of FIGS. 9-11;

FIG. 15B is a plan view of the disposable heater sleeve of FIG. 15A, taken from line 15B-15B of FIG. 15A;

FIG. 16A is a perspective view of the heater array of the lighter module of FIGS. 9-11;

FIG. 16B is a longitudinal cross-sectional view of the heater array of FIG. 16A, taken from line 16B-16B of FIG. 16A;

FIG. 16C is a cross-sectional view of the heater array of FIG. 16A, taken from line 16C-16C of FIG. 16A;

FIG. 17A is a perspective view of the heater spacer of the lighter module of FIGS. 9-11;

FIG. 17B is a plan view of the heater spacer of FIG. 17A, taken from line 17B-17B of FIG. 17A;

FIG. 17C is a plan view of the heater spacer of FIG. 17A, taken from line 17C-17C of FIG. 17A;

FIG. 17D is a cross-sectional view of the heater spacer of FIG. 17A, taken from line 17D-17D of FIG. 17B;

FIG. 18A is a perspective view of the heater retaining ring of the lighter module of FIGS. 9-11;

FIG. 18B is a plan view of the heater retaining ring of FIG. 18A, taken from line 18B-18B of FIG. 18A;

FIG. 18C is a plan view of the heater retaining ring of FIG. 18A, taken from line 18C-18C of FIG. 18A;

FIG. 19A is a perspective view of the common connector of the lighter module of FIGS. 9-11;

16A ✓
16B ✓
17A-C maybe? (too much like a blueprint?)
18A-C — DITTO
19A,B — DITTO
20A-C — DITTO

21 superfluous?
22-A-C ✓
23A unnecessary?
23B ditto
23C ?

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FIG. 19B is a longitudinal cross-sectional view of the common connector of FIG. 19A, taken from line 19B-19B of FIG. 19A;

FIG. 20A is a perspective view of the sizing ring of the lighter module of FIGS. 9-11;

FIG. 20B is a plan view of the sizing ring of FIG. 20A, taken from line 20B-20B of FIG. 20A;

FIG. 20C is a cross-sectional view of the sizing ring of FIG. 20A, taken from line 20C-20C of FIG. 20A;

FIG. 21 is a perspective view of the common connector attached to the heater array of the lighter module of FIGS. 9-11;

FIG. 22A is a perspective view of the spring switch of the lighter module of FIGS. 9-11;

FIG. 22B is a plan view of the spring switch of FIG. 22A, taken from line 22B-22B of FIG. 22A;

FIGS. 23A-23C illustrate a first embodiment for manufacturing the heater array of the lighter module of FIGS. 9-11;

FIGS. 24A-24H illustrate a second embodiment for manufacturing the heater array of the lighter module of FIGS. 9-11;

FIG. 25 is a perspective view of a serpentine heater element in accordance with the present invention;

FIG. 26A is a fragmentary plan view of an asymmetrical electrical connection to a serpentine heater element;

FIG. 26B is a cross-sectional view of the heater element of FIG. 26A, taken from line 26B-26B of FIG. 26A;

FIG. 27A is a fragmentary plan view of a symmetrical electrical connection to a serpentine heater element;

FIG. 27B is a cross-sectional view of the heater element of FIG. 27A, taken from line 27B-27B of FIG. 27A;

FIGS. 28A-28C illustrate the bending of an electrical heater element due to thermal or other stresses; and

FIG 24A unnecessary
24B maybe " " ?
24C maybe ?
24D,E,F DITTO
24G,H ?

FIG 25 unnecessary
of remarks
FIG 28 ~
seems important

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FIG. 29 is a longitudinal cross-sectional view of another lighter module embodiment.

Detailed Description of The Preferred Embodiments

The smoking system ~~can be~~ used ~~for example~~ in the same fashion as a cigarette. In such a case, the tobacco flavor medium would be a material containing tobacco or tobacco derivatives. The smoking system includes a removable cigarette cartridge which may be disposed of or discarded after one or more puff cycles, and a lighter module which may be disposed of or discarded after the same number of puff cycles, or after a higher number of puff cycles.

The cigarette cartridge includes the tobacco flavor medium, a filter to prevent ~~undesirable deposition~~ condensation of aerosol condensate on ~~permanent portions~~ components of the lighter and, if desired, a free-flow filter for filtering main-stream aerosol prior to delivery to the smoker. Additionally, the cigarette cartridge also includes an outer wrapper and surface for allowing air to pass therethrough for improving aerosol and flavor delivery to the smoker, as will be discussed below.

The removable cigarette cartridge of the smoking system is inserted into a reusable permanent housing including a source of electrical energy, a lighter module with a set of reusable heating elements, and control circuitry for energizing the heaters in an appropriate sequence, in response to manual actuation or, more preferably, puff-induced actuation. Preferably, the present invention also includes control circuitry for delivering a predetermined amount of electrical energy to each heater upon activation, independent of the power supply loaded voltage, as described in above-incorporated United States Patent Application Serial No. 07/943,504, filed September 11, 1992.

The permanent housing includes a lighter module that has a cavity at the mouth end thereof for insertion of the remov-

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see my covered letter

Sue Wrenn

flavor material and aerosol cavity, the region adjacent the heaters are in direct air-flow communication with the tobacco flavor material and aerosol cavity to provide the transverse air flow contours discussed above.

Additionally, a back-flow filter is preferably provided with the cigarette cartridge to reduce or substantially prevent the back flow of aerosol from the tobacco flavor cavity towards the power source components and control circuit. Such back flow of aerosol may give rise to the generation of undesirable flavors if the aerosol is able to condense onto surfaces that may be elevated in temperature.

The cigarette cartridge also includes a carrier which supports the tobacco flavor medium and provides for the separation between the lighter modules and the flavor medium. Such carriers transfer heat generated by the lighter modules to the flavor medium.

Preferred carriers comprise a non-woven carbon fiber mat, are discussed in greater detail in above-incorporated United States Patent Application Serial No. 07/943,504 and copending commonly-assigned United States Patent Application Serial No. 07/943,747, filed September 11, 1992, which is hereby incorporated by reference in its entirety.

Other carriers include low mass, open mesh metallic screens or perforated metallic foils. For example, a screen having a mass in the range from about 5 g/m^2 to about 15 g/m^2 and having wire diameters in the range from about 0.038 mm (about 1.5 mils) to about 0.076 mm (about 3.0 mils) could be used. Additionally, a 0.0064 mm (about 0.25 mil)-thick foil (e.g., aluminum) having perforations with diameters in the range from about 0.3 mm to about 0.5 mm, to reduce the mass of the foil by about 30 percent to about 50 percent, respectively, could also be used. Preferably, the perforation pattern of such a foil is staggered or discontinuous (i.e., not in straight arrangement) to reduce the lateral conduction of heat away from the tobacco flavor material.

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Such metallic screens and foils ~~could be~~ are incorporated into a cigarette cartridge in a variety of ways including, for example, (1) casting a tobacco flavor slurry on a belt and overlaying the screen or foil carrier on the wet slurry prior to drying, and (2) laminating the screen or foil carrier to a tobacco flavor base sheet or mat with a suitable adhesive. Because of the possibility that a metallic carrier could cause electrical shorting in or between the heaters, such carriers should generally not be in direct contact with the heaters. For example, suitable binders and low basis weight paper could be used to provide electrical insulation between the metallic carrier and the electrical heaters.

Whichever type of carrier is used, tobacco flavor material which is disposed on the inner surface of the carrier can be any material that liberates flavors when heated and is able to adhere to the surface of the carrier. Such materials include continuous sheets, foams, gels, dried slurries, or dried spray-deposited slurries, which may or may not contain tobacco or tobacco-derived materials, and which are more fully discussed in the above-incorporated United States Patent Application Serial No. 07/943,747. It is desirable that the tobacco flavor material contain an aerosol precursor to deliver the flavor containing substance as an aerosol, so that when the smoker exhales the flavor containing substance, the visible condensed aerosol may mimic the appearance of conventional cigarette smoke.

As will be discussed below, the smoking system preferably ~~may also~~ include an optional removable heater sleeve that protects the inner surfaces of the lighter module from exposure to residual aerosol generated in the heater regions. The removable heater sleeve can be made from a heat-resistant paper- or plastic-like material that can be replaced by the smoker after a plurality of cigarette cartridges have been smoked.

Thus, in contrast to the aerosol barrier tube attached to the tobacco flavor unit described in above-incorporated

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United States Patent Application Serial No. 07/943,504, which is discarded with the flavor unit after it has been smoked, the removable inner sleeve of the present smoking system is re-used. This simplifies the manufacturing of the cigarette cartridge, reduces the volume of material that is discarded after each cigarette cartridge has been smoked and, therefore, can also reduce cost to the smoker. As will be discussed below, because residual aerosol has been reduced in the heater regions of the smoking system. the need to replace the surfaces exposed to the heaters has also been reduced.

The parameters of the lighter modules are chosen to allow delivery of an effective amount of tobacco flavor substance, e.g., an aerosol containing tobacco flavors, to the smoker under standard conditions of use. For example, it may be desirable to deliver about 7 to 9 mg total of aerosol to a smoker for 8 puffs, each puff being a 35 ml puff having a two-second duration.

It has been found that in order to achieve such delivery, the heaters should be able to reach a temperature of between about 200°C and about 700°C when in thermal transfer relationship with the cigarette cartridge. Further, the heaters should preferably consume between about 5 and about 40 Joules of energy, more preferably between about 10 Joules and about 25 Joules, and even more preferably about 20 Joules.

Heaters having such characteristics preferably have an active surface area of between about 3 mm^2 and about 25 mm^2 and preferably have a resistance of between about 0.5 Ω and about 3.0 Ω. More preferably, the heaters should have a resistance of between about 0.8 Ω and about 2.1 Ω. Of course, the heater resistance will also be dictated by the particular power source that is used to provide the necessary electrical energy to heat the heaters. For example, the above heater resistances correspond to embodiments where power is supplied by four series-connected nickel-cadmium

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battery cells with a total power source voltage of approximately 4.8 to 5.8 volts. In the alternative, if six or eight such series-connected batteries are used, the heaters should preferably have a resistance of between about 3 Ω and about 5 Ω or between about 5 Ω and about 7 Ω, respectively.

The materials of which the heaters are made are preferably chosen to assure reliable repeated uses of at least 1,800 on/off cycles without failure. The heater materials are also chosen based on their oxidation resistance and general lack of reactivities, to assure that they will not oxidize or otherwise react with the cigarette cartridge at any temperature likely to be encountered to form any undesired compounds. Similarly, the heaters themselves should not evolve any undesired compounds even when heated out of the presence of the tobacco flavor medium. Alternatively, heaters that might otherwise evolve undesired compounds could be encapsulated in an inert heat-conducting material such as a suitable ceramic material.

Based on these criteria, materials for the electric heating means include doped semiconductors (e.g., silicon), carbon, graphite, stainless steel, tantalum, metal ceramic matrices, and metal alloys, such as, for example, nickel-, chromium- and iron-containing alloys. Suitable metal-ceramic matrices include silicon carbide aluminum and silicon carbide titanium.

More preferably, however, the electric heaters are made from a heat-resistant alloy that exhibits a combination of high mechanical strength and resistance to surface degradation at high temperatures. For example, preferably, the heaters are made from a material that exhibits high strength and surface stability at temperatures up to about 80 percent of their melting points. Such alloys are commonly referred to as super alloys and are generally based on nickel, nickel-chromium or nickel-iron. Preferably, the super alloy of the heaters includes aluminum to further improve the heaters

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performance (e.g., oxidation resistance). Such a material is available from Haynes International, Inc. of Kokomo, Indiana, under the name Haynes® 214™ alloy. This high-temperature material contains, among other elements, about 75% nickel, about 16% chromium, about 4.5% aluminum and about 3% iron by weight.

An embodiment of a smoking system 10 is shown in FIGS. 1-4. System 10 includes a reusable or permanent housing 20 and removable cigarette cartridge 21 which is received in a cavity 30 at the end of housing 20.

Housing 20 includes, at the end remote from the mouth end, a power source 22, which could include a battery, a capacitor or both. The battery could be replaceable, rechargeable or both. If the battery is rechargeable, or if the power source 22 is a capacitor alone, then system 10 is provided with charging contacts (not shown) on its outer surface, for connection to an external power supply for charging power source 22. Power source 22 provides power for the heating elements of system 10 (to be discussed below), which are energized under the control of control circuit 24, which is in turn preferably activated by a puff-actuated sensor 24A. Indicator 26, which comprises a seven-segment liquid crystal display capable of displaying the digits "0" through "8", reflects the status of the various heaters 23. Reset button 25 is used to reset control circuit 24 so that it displays the digit "8" on indicator 26.

The functions of power source 22, control circuit 24, puff-actuated sensor 24A and indicator 26 are described in more detail in above-incorporated United States Patent No. 5,060,671 and United States Patent Application 07/943,504, filed September 11, 1992.

Housing 20 includes a removable cover 20a for allowing power supply 22 to be replaced. Housing 20 is made from a hard heat-resistive material such as a hard metal-based or polymer-based material. In the present embodiment, housing

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20 has overall dimensions of about 10.7 cm by about 3.8 cm by about 1.5 cm and is adapted to fit in the hand of the smoker. Of course, other shapes and sizes for housing 20 could be used as well.

Mounted inside housing 20, at the mouth end, is lighter module 35 to be discussed in more detail below. Lighter module 35 includes cavity 30 for inserting disposable tobacco unit 21. As shown in FIGS. 4A and 4B, disposable tobacco unit 21 preferably includes flavor generating material 27 positioned on carrier 36, optional free-flow filter 28, an optional back-flow filter 29 and mouthpiece filter 46. Carrier 36, in addition to attaching a free-flow filter 28 to back-flow filter 29, physically separates heater elements 51 from tobacco flavor material 27. The cigarette cartridge 21 also includes outer wrapper 37, which allows transverse air flow therethrough, as to be discussed below, and tipping paper 47 for attaching mouthpiece filter 46 to free-flow filter 28.

When cigarette cartridge 21 is inserted in cavity 30 of lighter module 35, the inside surfaces of the heater elements (not shown in FIGS. 1-4) are adjacent tobacco flavor material 27 to facilitate flavor and aerosol generation, but are separated from it by carrier 36 and outer wrapper 37. Preferably, optional back-flow filter 29 should fit snugly into the bottom of cavity 30. The purpose of this filter is to minimize the effect of aerosol which flows backwards from aerosol cavity 27A towards power source 24 of system 10 while allowing a predetermined amount of longitudinal air flow through the cigarette cartridge. Such back flow can result in the condensation of aerosol onto the electrical portions and other permanent structural components of system 10. Subsequent reheating of such condensation can produce undesirable flavors that may be delivered to a consumer. If desired, back-flow filter 29 could be replaced with a plug for structurally supporting the cigarette cartridge while allowing minimal longitudinal air flow through the cigarette

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cartridge. In such an embodiment, the air flow through the cigarette cartridge would be provided substantially by transverse air flow.

Adjacent the mouth side of tobacco flavor material 27 is optional free flow filter 28. The primary purpose of free-flow filter 28 is to provide structural support and facilitate attachment of carrier 36 and back-flow filter 29 to unit 21. Thus, free-flow filter 28 preferably has a low resistance-to-draw (i.e., provides for the free flow of aerosol or vapor). If desired, free-flow filter 28 can be designed to provide a predetermined amount, generally small, of filtration of aerosol or vapor.

Adjacent free-flow filter 28, on the opposite side of aerosol cavity 27A, is additional optional mouthpiece filter 46, which is provided mostly for the sake of appearance and to give system 10 a mouth feel similar to a conventional cigarette. Although not shown in FIGS. 4A and 4B, a gap may be inserted between free-flow filter 28 and mouth piece filter 46 (e.g., from about 2 mm to about 10 mm) to expose more inner surface area of filter 46 to aerosol.

Free-flow filter 28, back-flow filter 29 and carrier 36 form an air passageway and aerosol cavity 27A (see FIGS. 4A and 4B) which allow for the generation and passage of aerosol and flavor to a smoker. Cavity 27A facilitates formation of aerosol by allowing space for condensation of droplets to occur while minimizing deposition of those droplets on internal surfaces of system 10.

Cavity 27A of cigarette cartridge 21 is adapted to provide particular air flow contours therethrough. Such air flow contours improve aerosol and vapor delivery to the smoker and also reduce the amount of condensation of aerosol in the heater regions of the smoking system. The contours are provided by a combination of particular designs for lighter module 35 and cigarette cartridge 21. More particularly, lighter module 35 includes a predetermined arrangement

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and number of air passageways for providing particular air flow contours in the smoking system. Such a lighter module improves aerosol and flavor delivery to the smoker. This aspect is first illustrated in FIG. 5.

As shown in FIG. 5, cigarette cartridge 21 is inserted into lighter module 35 which includes air channel sleeve 51 and heaters 52. During smoking, two main types of vapor and aerosol are generated by the activation of heaters 52. Tobacco cavity vapor/aerosol (identified by reference numerals 54 and 61) is generated internal to cigarette cartridge 21. Heater region vapor/aerosol (identified by reference numeral 153), is generated in the heater regions of lighter module 35 external to cigarette cartridge 21.

Air channel sleeve 51 is configured for forming air flow contours 55, 56, 57 and 58 through cigarette cartridge 21. Air flow contour 55 runs along the longitudinal axis 60 of cigarette cartridge 21 and is facilitated by optional back-flow filter 29 discussed above.

The electrical smoking systems also include air flow contour 56 for providing transverse, or radial, air flow through the side walls of cigarette cartridge 21 in the regions adjacent lighter modules 52. Longitudinal contours 55 and radial contours 56 combine and mix to produce air flow contours 57, adjacent free-flow filter 28. Contours 57 subsequently provide air flow contours 58, which deliver aerosol and vapor to the smoker.

The purpose of radial air flow contours 56 is two-fold. First, air flow contours 56 are adapted to remove residual and stagnant heater-region vapor/aerosol 53 by moving such vapor/aerosol from the heater region where it is generated to a region internal to cigarette cartridge 21. If not removed, such stagnant vapor/aerosol may otherwise condense on heaters 52 and wails 51B of heater cavity 51. Thus, because of the introduction of radial air flow contours 56 into the smoking

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TO: Joseph Magnone

FROM: CEB GLENN

DATE: 08-11-93

SUBJECT: PM 1697

PAGES TO FOLLOW: -24-

MESSAGE:

CONFIDENTIAL

PLEASE REPORT ANY TRANSMISSION PROBLEM TO (804) 274-5307.

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August 11, 1993

Joseph Magnone, Esq.
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Dear Joe:

Regarding PM 1697, on page 12, line 17-22, please note that the old process for forming the fiber mat was primarily executed by forming a non-woven carbon fiber mat and then coating the carbon mat with tobacco material.

Presently we form a base mat using a paper making process, wherein:

1) tobacco strip is washed with water, whereupon the solubles are used in a later coating step and the remaining (extracted) tobacco fiber is used in the construction of a base mat;

2) we disperse carbon fibers in water and add sodium alginate (or any other gum that will provide the desired viscosity);

3) we mix the dispersion from the previous step with the slurry of extracted tobacco fiber and (optionally) add traditional flavors;

4) we then wet lay the resultant mixture onto a fourdrinier wire and pass the web along the remainder of a traditional paper making machine;

5) we then apply the tobacco extracts of step 1 onto one side of the base web, preferably with resort to a standard reverse roll coater located after the Yankee dryer (the coating step could produced off-line as well).

Flavors could be added with the coating step or after the coating step, instead of with the base mat forming steps.

Very truly yours,

Charles E. B. Glenn

CEBG/drs

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SHOULD PM 1697 INCLUDE A CLAIM AS BELOW?

A cigarette cartridge comprising:

a substantially cylindrical, thermally transmissive base web having a first surface for receiving heat and an opposite surface;

a tobacco material disposed along the opposite surface of the base web, for liberating the tobacco flavor when heated by heat transmitted through the base web; and

a wrapper located about said base web.

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able cigarette cartridge. The reusable heaters of the lighter module are disposed in the heater cavity in such a way that they are in thermal transfer relationship with the disposable tobacco unit when the unit is inserted into the cavity. Direct contact is needed for optimum thermal transfer. This is accomplished by having the heaters protrude from the sides of the cavity and by making the removable cigarette cartridge slightly compressible, so that the heaters press into the disposable unit.

When reusable heaters are used, it is important that condensation of aerosol onto power source components, control circuitry, and other permanent structural portions, and particularly the heating elements, of the system be minimized. Otherwise, residues from a previous use (i.e., fixture contamination), which might include partially oxidized, pyrolized or thermally decomposed constituents of the tobacco flavor medium, might be reheated, possibly giving rise to ~~undesirable compounds~~ and off tastes being delivered to the smoker. Such residues are not of concern when the heaters are disposable, as in above-discussed U.S. Patent No. 5,060,671, because normally they are never reheated, but may be of concern where reusable heaters are provided.

As will be discussed in more detail below, the heater cavity includes a predetermined arrangement and number of air passageways for providing both longitudinal and transverse (e.g., radial) air flow contours through the cigarette cartridge. The transverse air flow contours through the outer wrapper and surface of the cigarette cartridge decreases the amount of condensation of aerosol in the heater regions of the system. The transverse air flow contours also improve aerosol and flavor delivery to the smoker. Also, reducing condensation of aerosol in the heater regions of the system therefore reduces aerosol residue reheating and ~~undesirable~~ flavor generation. Although separated from the tobacco

either move this discussion of the particulars of the end cap to the discussion of the preferred embodiment

Please clearly the discussion so we are not vilifying our glorious earlier designs

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system, condensation of residual heater-region vapor/aerosol is reduced.

Second, the introduction of radial air flow contours 56 into the smoking system has also been found to improve TPM and flavor delivery to the smoker. In the smoking system, it is desirable that as much as possible of the aerosol and vapor generated by cigarette cartridge 21 is delivered to the smoker. In other words, it is desirable that the contents of the tobacco flavor material, and not the air flow contours in the smoking system, limit the aerosol and vapor delivery to the smoker. This allows the manufacturing of cigarette cartridge 21 to control the aerosol and vapor delivered to the smoker. For example, a first cigarette cartridge could be designed to provide a first level of TPM (e.g., 10 mg), while a second could be designed to provide a second level (e.g., 6 mg) at similar heater energy settings.

Otherwise, if the smoking system allowed for the generation of aerosol and vapor in cigarette cartridge 21, but the air flow contours limited delivery of such aerosol and vapor to the smoker, then the smoking system would be inefficient. In particular, more aerosol and vapor would be available to condense on the heaters and other permanent components of the lighter module. Additionally, such a smoking system may not have the ability to deliver differing amounts of aerosol and vapor to the smoker by altering the tobacco flavor material. In other words, delivery would be limited by the air flow contours of the smoking system and not the cigarette cartridge.

The lighter module of the smoking system controls air flow contours 55 and 56 to improve flavor delivery as discussed above. More particularly, the lighter module provides a substantially airtight cavity except for the provision of specific air passageways which control air flow contours 55 and 56. Outer wrapper and surface 21B of cigarette cartridge 21 are adapted to allow air to pass therethrough.

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FIGS. 6-8 illustrate various lighter module embodiments to provide air flow contours 55 and 56 in accordance with the principles of the present invention.

FIGS. 6A and 6B illustrate a lighter module 70 with a pair of longitudinal air passageways 71 and 72 and a set of eight equally spaced radial air passageways 73. Longitudinal air passageways 71 are positioned adjacent back-flow filter 29 and provide longitudinal air flow contours 55. Radial air passageways 73 are positioned through the cylindrical surface of lighter module 70, at points substantially midway between the ends 75A and 75B of heaters 75, and provide transverse or radial air flow contours 56. In accordance with the present invention, except for passageways 71, 72 and 73, lighter module 70 is a substantially air-tight cavity. In other words, air flow contours 57 and 58 are provided substantially only by passageways 71, 72 and 73.

FIGS. 7A and 7B illustrate a lighter module 80 with a single longitudinal air passageway 81 and a set of eight equally spaced radial air passageways 82. Longitudinal air passageway 81 is positioned adjacent back-flow filter 29 and provides longitudinal air flow contours 55. Radial air passageways 82 are positioned through the cylindrical surface of lighter module 80, at points substantially at the rear of lighter module 80 remote from heaters 84 and adjacent back-flow filter 29. Passageways 82 provide radial air flow contours 56. In accordance with the present invention, except for passageways 81 and 82 lighter module 80 is a substantially air-tight cavity. In other words, air flow contours 57 and 58 are provided substantially only by passageways 81 and 82.

FIGS. 8A and 8B illustrate a lighter module 90 with a single longitudinal air passageway 91 and a set of eight equally spaced radial air passageways 92. Longitudinal air passageway 91 is positioned similarly to passageway 81 in FIGS. 7A and 7B. Radial air passageways 92 are positioned

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through the front surface 90A of lighter module 90. Although passageways 92 are not directed through the wall of lighter module 90 in a radial direction, passageways 92 still provide for radial air flow contours 56 through cigarette cartridge 21.

If desired, the lighter module illustrated in FIGS. 6A, 6B, 7A, 7B, 8A and 8B could just as well be provided without longitudinal air passageways 71, 72, 81 and 91. Such units would include passageways for solely providing transverse air flow.

Thus, a lighter module for a smoking system has been described that provides for both longitudinal and transverse (e.g., radial) air flow contours through a cigarette cartridge having an outer wrapper and surface for allowing air to pass therethrough. Such contours improve the flavor and aerosol delivery to the smoker and reduce condensation of residual aerosol onto the permanent portions of the smoking system in the regions adjacent the lighter modules.

As discussed above, the heater is adapted to provide transverse (e.g., radial) air flow contours through the cigarette cartridge. In turn, the cigarette cartridge is also adapted to facilitate such air flow. More particularly, the cigarette cartridge includes an outer wrapper and surface to allow air flow therethrough. In accordance with the present invention, air flow through the outer wrapper and surface of the cigarette cartridge can be accomplished in various ways.

For example, perforations could be provided through the outer wrapper and surface of the cigarette cartridge in the regions adjacent the aerosol cavity. In particular, for the embodiment of the cigarette cartridge 21 shown in FIGS. 4A and 4B, perforations having a density of approximately 1-2 holes per square mm and a hole diameter of between about 0.4 mm and about 0.7 mm could be provided through carrier 36 and tobacco flavor material 27 adjacent aerosol cavity 27A. For

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